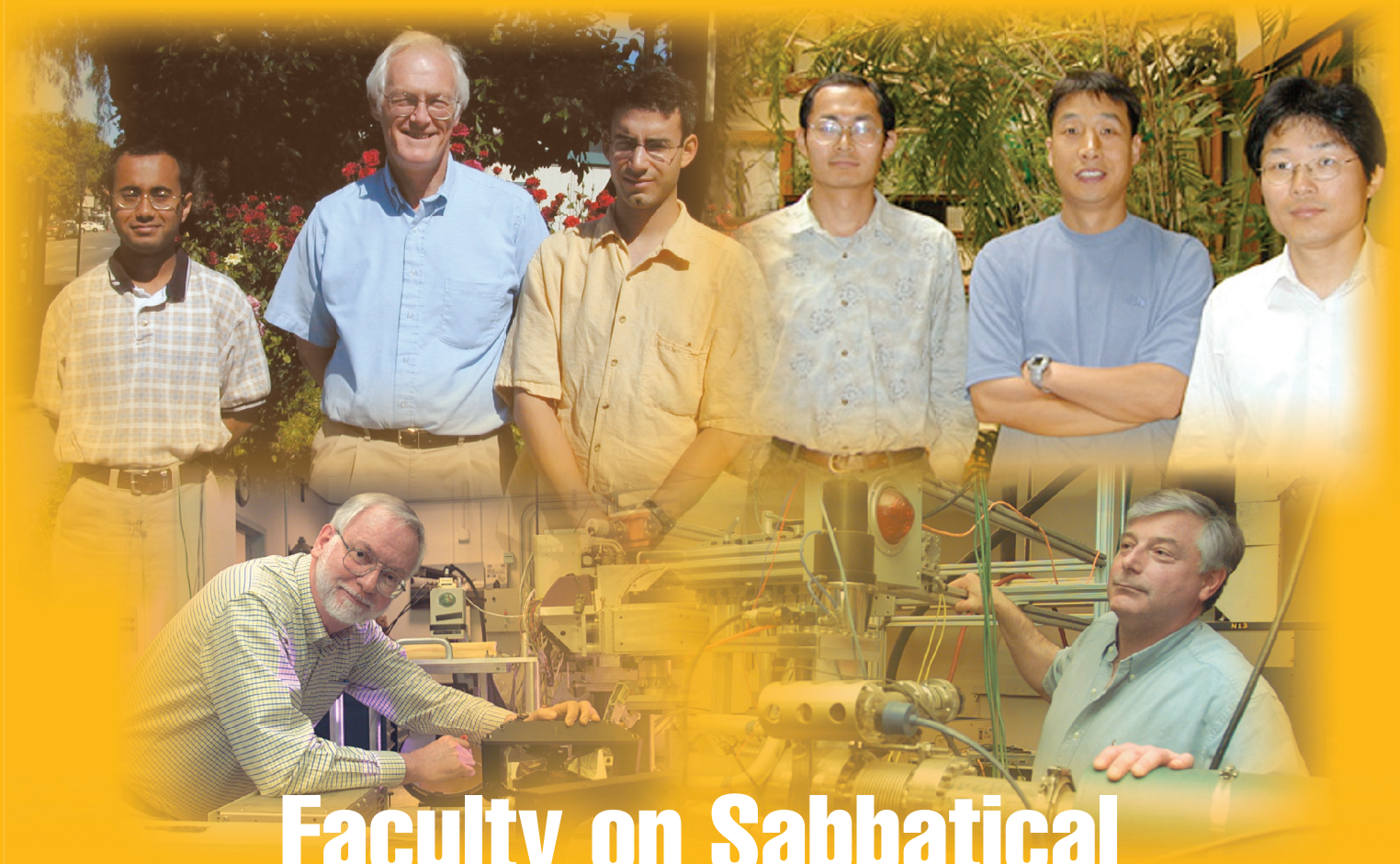


Faculty on Sabbatical

Find a Good Home at Livermore

Livermore's Sabbatical Scholars Program is attracting top academic scientists and their students to the Laboratory.

FOR university faculty members, a sabbatical leave is one of the most valued perks of academic life. Typically, a sabbatical means an opportunity every seventh year to conduct research for several months, or sometimes a full academic year, without a teaching workload. An increasing number of faculty members are choosing to spend their sabbaticals at Lawrence Livermore.

Livermore's Sabbatical Scholars Program was designed to bring topflight scientific and engineering expertise to the Laboratory. This program gives visiting professors the opportunity to conduct research at one of the world's premier applied science and engineering research centers, and Livermore scientists have the opportunity to collaborate with some of the best scientific minds in the world. The

established ties serve to strengthen the recruitment of outstanding young scientists and engineers.

"Our sabbatical program is a cost-effective way to take advantage of the outstanding scientists in the nation and the world," says Harry Radousky, deputy director of Livermore's University Relations Program (URP). URP was formed in 1995 to facilitate the growing number of collaborations between Laboratory researchers and academic institutions. "Strong interactions between the university community and Lawrence Livermore are vital to the continuing success of the Laboratory's missions," says Radousky. (See *S&TR*, October 2004, pp. 14–23.)

URP advertises the program annually in science journals, such as *Science* and *Nature,* and through promotions on selected university campuses, particularly those in the University of California (UC) system. In many cases, Laboratory researchers encourage their university collaborators to apply.

Painless Application Process

"We try to make the application process as painless as possible," says URP's Paul Dickinson, who manages the Sabbatical Scholars Program. Applicants fill out an interest form located on URP's Web site and submit a curriculum vita and brief description of the research they propose to conduct at Livermore. According to Dickinson, some applicants have already collaborated with Livermore researchers, know one or more Livermore scientists, or have visited the Laboratory. Others are attracted by Livermore's reputation in applied science and engineering.

Applications are due May 1 each year, but they are reviewed quarterly until available resources are committed. Applications are first screened by the potential host Laboratory directorate to determine if there is a good match for the applicant and a Livermore program that would benefit from the sabbatical. Applications are then formally reviewed by the same Laboratory-wide committee that selects the Lawrence Fellows (outstanding postdoctoral scholars; see *S&TR,* November 2002, pp. 12–21). Sabbatical candidates are evaluated on their records of achievement and the strength of their research proposals. The committee ranks all applicants and chooses four to six faculty members per fiscal year for sabbaticals that can range from 3 to 15 months.

A unique feature of the program is the inclusion of graduate students and postdoctoral researchers in a faculty member's sabbatical stay at the Laboratory. "Encouraging faculty to bring outstanding students and postdocs with them has proved to be very popular," says Dickinson. The number of students and the duration of their visit to Livermore are negotiated with each faculty participant. Dickinson explains that when faculty members return from a typical sabbatical, they have to "restart" their students' research programs. Under the Livermore program, students return to campus with little break in continuity of their studies.

Since the program's inception in 2000, 22 faculty members have been Livermore Sabbatical Scholars, and 33 of their students and postdoctoral researchers have joined them at Livermore. Faculty members have come from universities throughout the U.S. as well as France, Italy, the Netherlands, and Japan. Six of the 22 professors have come from the UC campuses at Berkeley (UCB), Davis (UCD), and Riverside (UCR). (See the box on p. 14.)

Livermore program directorates have been extremely pleased with the faculty–student teams that the Sabbatical Scholars Program has attracted. "In many cases, faculty–student teams working at the Laboratory for 3 to 12 months have made significant contributions to our technical programs or helped establish new capabilities," says Dickinson. "In most instances, collaborations were established that continue to grow in scope."

The program has also proven to be cost-effective. In most cases, faculty on sabbatical have some fraction (often 80 to 100 percent) of their salary paid by their home institution. As a result, Livermore's costs are usually limited to temporary housing and travel expenses for the professor and any students.

First Sabbatical Scholar

Richard Martin, professor of physics at the University of Illinois at Urbana-

In 2001, University of Illinois physicist Richard Martin (center) was the first participant in the Laboratory's Sabbatical Program. During Martin's sabbatical, three of his graduate students visited Livermore for extended periods, and two of his postdoctoral researchers (shown here with Martin) made short visits.

Champaign, was the first program participant, with a 14-month sabbatical that began in July 2001. At its conclusion, he characterized his sabbatical as "a stimulating, profitable, and enjoyable experience."

Martin, an expert on the electronic properties of solids, proved how productive a sabbatical at Livermore could be. Martin's hosts were physicists Andy McMahan and Giulia Galli in the Physics and Advanced Technologies (PAT) Directorate's H Division, which researches the behavior and structure of materials under extreme conditions. Martin was located in the Laboratory's Materials Research Institute (MRI), where he could interact with a wide range of Livermore scientists.

Martin worked with McMahan and physicists David Young and Jim Albritton on improving quantum models used to generate equations of state. In another project, Martin and McMahan researched

University Relations Program's Sabbatical Scholars Program

Name	University	Dates onsite	Students/ postdocs	Host directorate	Host
Richard Martin	University of Illinois, Urbana-Champaign	07/01–08/02	5	Physics and Advanced Technologies	Giulia Galli, Andy McMahan
James Hunt	University of California, Berkeley	09/01–08/02	2	Energy and Environment/ Chemistry and Materials Science	Ken Jackson, Jesse Yow
James Orr	University of Pierre and Marie Curie (France)	09/01–08/02	2	Energy and Environment	Ken Caldeira
Joonhong Ahn	University of California, Berkeley	01/02–10/02	2	Energy and Environment	Bill Halsey
Herbert Edelsbrunner	Duke University	01/02–06/02	2	Computation	David Keyes
James Carlson	University of California, Davis	04/02–06/02	1	Physics and Advanced Technologies	Steve Visuri
Carlo Bottasso	Politecnico di Milano (Italy)	06/02–11/02	2	Engineering/Computation	Dennis Parsons
Stanley Prussin	University of California, Berkeley	08/02–05/03	2	Nonproliferation, Arms Control, and International Security	Tom Gosnell
Stephen Park	University of California, Riverside	09/02–05/03	0	Energy and Environment	Jeff Roberts
Joyce Penner	University of Michigan	09/02–09/03	3	Energy and Environment	Doug Rotman
Peter Pacheco	University of San Francisco	09/02–05/03	1	Computation	Patrick Miller
James Badro	University of Pierre and Marie Curie (France)	12/02–03/03	0	Energy and Environment	Daniel Farber
R. Paul Drake	University of Michigan	01/03–09/03	2	National Ignition Facility Programs	Bruce Remington
Michael Walter	Okayama University (Japan)	01/03–03/04	0	Chemistry and Materials Science	Joseph Zaug
John Trangenstein	Duke University	01/03–05/03	2	Computation	Richard Hornung
Alexander Tielens	Kapteyn Astronomical Institute (Netherlands)	06/03–08/03	3	Physics and Advanced Technologies	Wil van Breugel
J. Ilja Siepmann	University of Minnesota	08/03–07/04	1	Chemistry and Materials Science	Chris Mundy
George Hepner	University of Utah	10/03–02/04	1	Energy and Environment	Bill Pickles
James Brennan	University of Toronto	03/04–05/04	0	Energy and Environment	Rick Ryerson
Edison Liang	Rice University	03/04–08/04	2	National Ignition Facility Programs	Bruce Remington
Edward Morse	University of California, Berkeley	09/04–05/05	0	National Ignition Facility Programs/ Physics and Advanced Technologies/ Nonproliferation, Arms Control, and International Security	Mike Moran
Scott Davis	Naval Postgraduate School	10/04–03/05	0	Nonproliferation, Arms Control, and International Security	Bill Conaway

strong electron correlation, a phenomenon encountered in some materials of Laboratory interest. In these materials, one cannot make the assumption that each electron in a solid interacts independently of all the other electrons. Martin also worked with physicists Andrew Williamson, Jeff Grossman, Galli, and others on Monte Carlo simulations and time-dependent density functional theory. Adding time dependence improves modeling capabilities based on this theory, such as the ability to predict energy gaps in solids.

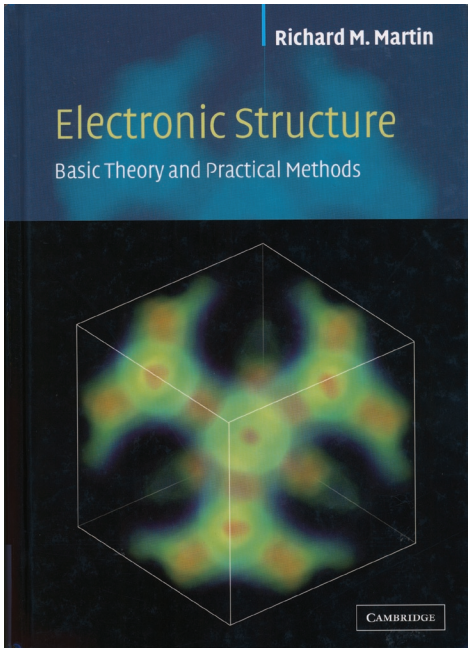
Three of Martin's graduate students visited Livermore for extended periods, and two of his postdoctoral researchers made short visits. Martin started an ongoing collaboration that included one of his students with physicist Mal Kalos of the Defense and Nuclear Technologies Directorate.

During Martin's stay, he also completed the book *Electronic Structure: Basic Theory and Practical Methods*, which was recently published by Cambridge University Press. "One outcome of Richard's many interactions with Laboratory staff was he became a member of the H Division Advisory Committee. He continues to visit the Laboratory about twice a year to sit on this oversight panel that assesses the division's progress," says McMahon.

Sabbatical scholars who have followed Martin include climate experts, nuclear physicists, engineers, computer scientists, and chemists. James Orr, an oceanographer whose research focuses on the cycling of carbon within the ocean and the exchange of carbon between the atmosphere and ocean, completed a year-long sabbatical in 2002. Orr is a scientist with the Laboratoire des Sciences du Climat et de l'Environment of the French Commissariat à l'Energie Atomique and the l'Institut Pierre-Simon Laplace. He is the international coordinator of the Ocean Carbon-Cycle Model Intercomparison Project, which compares and improves three-dimensional numerical models of the ocean.

During his sabbatical, Orr worked with Livermore's Climate and Carbon Cycle Group in the Atmospheric Sciences Division of the Energy and Environment Directorate to achieve the highest resolution simulations of carbon transport with an atmospheric model that had yet been produced. This work led to new projects funded by the National Aeronautics and Space Administration and the Department of Energy (DOE). A strong collaboration continues between Livermore and Orr's group in France.

Joonhong Ahn, associate professor in nuclear engineering at UCB, spent a nine-month sabbatical at Livermore in 2002. Ahn and two of his graduate students studied the relationship between the nuclear fuel cycle and geologic disposal. Their work led to the development of a nuclear fuel cycle mass-flow model for transmuting wastes with an accelerator. Ahn's sabbatical resulted in an expanded collaboration between Livermore



During physics professor Richard Martin's sabbatical, he completed the book *Electronic Structure: Basic Theory and Practical Methods*, which was recently published by Cambridge University Press.

Joonhong Ahn (left), associate professor in the Department of Nuclear Engineering at the University of California at Berkeley, spent a nine-month sabbatical at Livermore in 2002 with two of his graduate students. The three researchers studied the relationship between the nuclear fuel cycle and geologic disposal.

and UCB's Department of Nuclear Engineering.

From Scholar to Chief Scientist

Another member of UCB's Department of Nuclear Engineering, Professor Stanley Prussin, had served for several years as a consultant to Livermore's Nonproliferation, Arms Control, and International Security (NAI) Directorate before his sabbatical from August 2002 to May 2003. During his Livermore sabbatical, Prussin became interested in a Laboratory Directed Research and Development (LDRD) project to develop a method for detecting the clandestine transport of nuclear weapons materials inside shipping containers. The challenge for NAI was to detect a very small amount of highly enriched uranium or plutonium buried inside a typical freight container. Such a detection system is required at the nation's seaports because currently only 2 percent of nearly 7 million shipping containers that enter the U.S. are inspected.

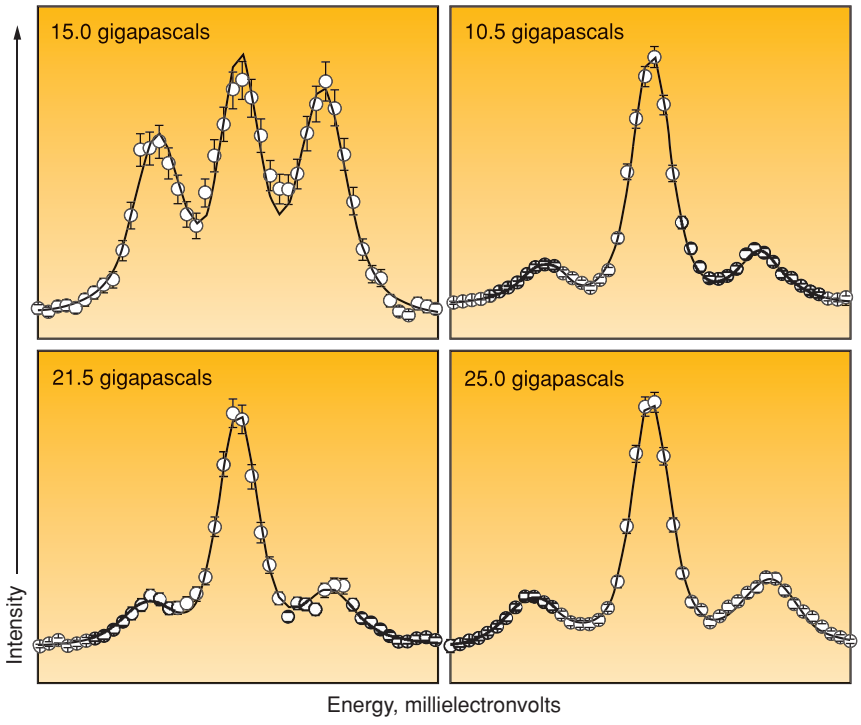
NAI physicist Tom Gosnell, who was Prussin's host, recalls Eric Norman of Lawrence Berkeley National Laboratory visiting Prussin at Livermore. Gosnell observes, "When you give two really smart guys an office and time to think, they can come up with great things." Prussin and Norman were instrumental in developing a detection system that may be 10,000 times more sensitive than other approaches under certain conditions. The system bathes suspicious containers with neutrons to actively search incoming shipments for smuggled nuclear materials. Prussin is currently project chief scientist. (See *S&TR*, May 2004, pp. 12–15.)

Two graduate students accompanied Prussin. One of them, Dave Peterson, was awarded a Student Employee Graduate Research Fellowship (SEGRF). Livermore's URP, in partnership with UC, provides these 4-year fellowships to students pursuing a Ph.D. at UC who are conducting their thesis research at the Laboratory. In 2004, there were about 50 SEGRF students at Livermore.

James Carlson, associate professor in the Department of Medical Pathology in the School of Medicine, and director of the Clinical Microbiology Laboratory at UCD's Medical Center, completed a three-month sabbatical at Livermore in 2002. He worked with Livermore's Medical Technology Program to define a project in the rapid diagnosis of respiratory viruses. While on sabbatical, he and one of his graduate students were able to carry out experiments using biomedical equipment developed at Livermore. Carlson is currently collaborating on a project funded by LDRD to develop a point-of-care pathogen-detection instrument.

Long-Term Collaboration

Geophysicist James Badro, from the Institut de Physique du Globe de Paris, France, was on sabbatical at Livermore from December 2002 to March 2003. His host was long-time collaborator Dan Farber, a high-pressure physicist in the Earth Sciences Division in the Energy and



Livermore physicist Daniel Farber and geophysicist James Badro, a sabbatical scholar from the Institut de Physique du Globe de Paris, France, have advanced scientific understanding of inelastic x-ray scattering of crystals, which measures a crystal's vibrations. These plots show some of the highest pressure and highest resolution single-crystal phonon dispersion (crystal lattice vibration) data ever collected. A beam of 20,000 electronvolts was directed in a longitudinal direction (left column) and then a transverse direction (right column) on a crystal of cobalt. The researchers recorded tiny (about 10-millielectronvolt) shifts in the crystal's vibrational energy, seen in the left- and right-hand peaks flanking the large central peak in each graph.

Environment Directorate. The two first met in Europe in 1994 at a conference. Two years later, Farber came across one of Badro's research papers. "It was one of the few times I've been stunned by a scientific paper," he says.

Later, Farber and Badro worked together for two years at the European Synchrotron Radiation Facility (ESRF) studying inelastic x-ray scattering of crystals. "We developed a technique that measures the modes of vibrations in crystals," says Farber. The work paved the way for a team that included Farber and was led by Livermore chemist Joe Wong to study phonon dispersions (crystal lattice vibration) of plutonium at ESRF. The team, funded by LDRD, produced new phonon data that greatly enhanced scientists' basic knowledge of the phases of plutonium. (See *S&TR*, January/February 2004, pp. 12–14.)

Badro's sabbatical continued the work on inelastic x-ray scattering and allowed the two physicists to generate ideas for new research that take advantage of Livermore's capabilities. Badro has returned to the Laboratory several times since his sabbatical ended in 2003. He and Farber currently have a long-term project supported by the Livermore branch of UC's Institute for Geophysics and Planetary Physics. The project focuses on new ways to obtain data on high-pressure, high-temperature materials.

"Livermore is attractive to many faculty members," says Farber. "We have great technical capabilities, and the campus encompasses a broad range of interests. Faculty members can interact with people doing different things and that can generate new collaborations. The sabbatical program encourages visitors to share their ideas and techniques and allows us to stay engaged with the broader scientific community."

Stephen Park, professor of geophysics with the Department of Earth Sciences and a researcher in the Institute of Geophysics and Planetary Physics branch at UCR, completed a nine-month sabbatical at the Laboratory in the summer of 2003. He partnered with Livermore physicist Jeff Roberts on a project funded by LDRD involving electrical resistivity monitoring of the San Andreas Fault at Parkfield, California. The scientists measured electrical conductivity of sediments adjacent to the fault. The measurements suggested the active portion of the fault at Parkfield may be offset by as much as 1,000 meters from the mapped surface break. (See *S&TR*, March 2005, pp. 22–23.)

Michael Walter, professor from Okayama University, Japan, spent a 13-month sabbatical (January 2003 through March 2004) that was jointly supported by Okayama University and Lawrence Berkeley and Lawrence Livermore national laboratories. Walter designed and constructed an advanced laser-heated diamond anvil cell (LHDAC) system for the new high-pressure beam line 12.2.2 at the Advanced Light Source (ALS) facility at Lawrence Berkeley, one of the world's brightest sources of ultraviolet and soft and hard x-ray beams.

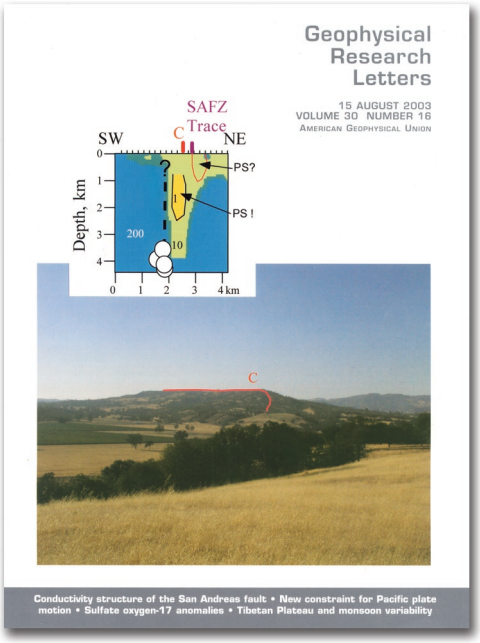
A diamond anvil cell (DAC) is a small mechanical press that forces together the small, flat tips of two diamond anvils, thereby creating extremely high pressures on a tiny sample of a material. Using a laser is an effective way to heat DAC samples. The ALS beam line enables scientists to study the structure of the sample being squeezed and heated in the DAC.

Walter has shared his LHDAC expertise with researchers in Livermore's Chemistry and Materials Science Directorate. In March 2004, he demonstrated how the LHDAC system heats water to well over 2,000 kelvins. "Walter was instrumental in building a laser heating system at the ALS that will enable us to learn about materials using x-ray diffraction as a probe when sample conditions extend to 3,000 or 4,000 kelvins and over 100 gigapascals," says Livermore chemist Joe Zaug, who was Walter's host.

Current Scholars

The most recent sabbatical scholars—Edward Morse from UCB and Scott Davis from the Naval Postgraduate School (NPS) in Monterey, California—arrived at Livermore in the fall of 2004. Morse is the third faculty member from UCB's Department of Nuclear Engineering to participate in the sabbatical program. As a reflection of Morse's unusually broad research interests, his stay is supported by three directorates: National Ignition Facility (NIF) Programs, NAI, and PAT.

Morse has been involved with Livermore for several years. His graduate student, Carlos Barrera, is completing his Ph.D. researching NIF physics. Barrera, in February 2005, was awarded a fellowship at Livermore under the SEGRF Program.



Geophysicist Stephen Park, a sabbatical scholar from the University of California at Riverside, partnered with Livermore physicist Jeff Roberts on a project involving electrical resistivity monitoring of the San Andreas Fault at Parkfield, California. Their work was reported in the August 15, 2003, issue of *Geophysical Research Letters*. (Copyright 2003 American Geophysical Union; reproduced by permission.)

Morse is working with Mike Moran and other Laboratory laser scientists to develop a neutron imaging diagnostic for NIF. Morse has overseen tests of the new detector using neutrons generated at both Livermore and UCB facilities. He has also developed detectors that use diamonds to achieve unprecedented sensitivity. "We're trying to design the diagnostics of the future," he says.

"Morse has been an important resource for us," says Moran, Morse's host. "He has maintained a relationship with Livermore that has evolved as our priorities, needs, and programs have evolved."

For PAT, Morse works closely with Livermore experts in neutron generation and detection. He runs a neutron generator at UCB that previously was located at Livermore. He is currently working with PAT managers on ways to make Livermore's Pelletron, a positron accelerator used to study radiation damage, available to UCB researchers. As an example of the close relationship between Livermore and UCB, Brian Wirth, a former Laboratory physicist, is the newest member of UCB's Nuclear Engineering staff and will oversee UCB access to the Pelletron.

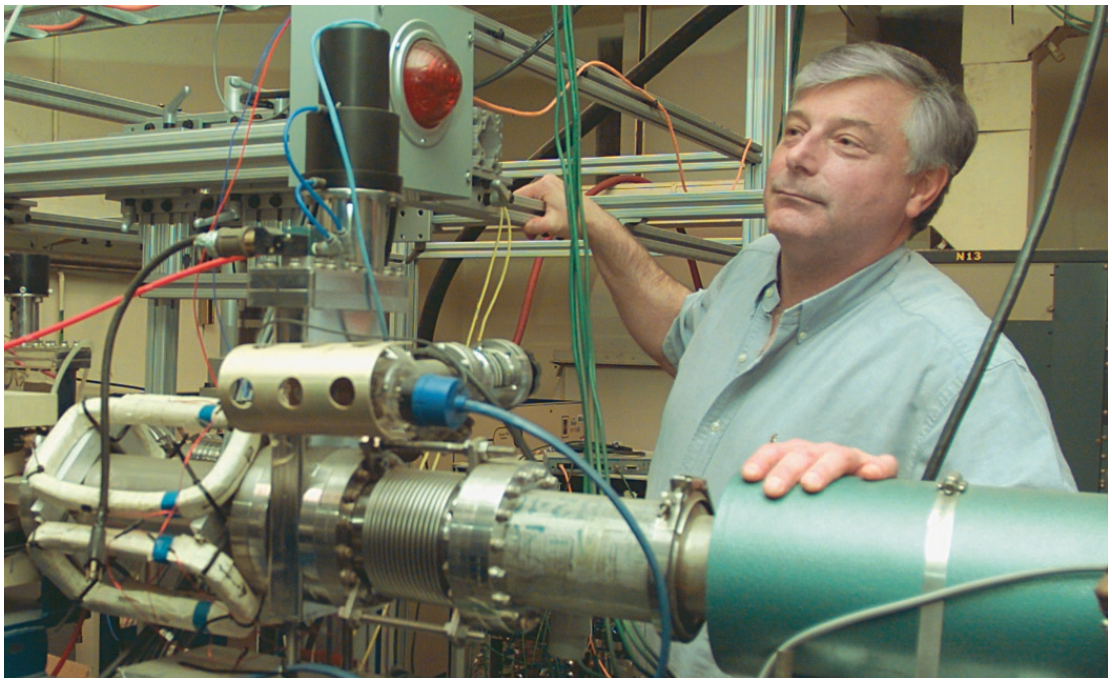
Morse has developed a graduate-student course on nuclear nonproliferation for the Western Nuclear Science Alliance, a DOE-sponsored consortium of college nuclear engineering programs. The two-week course, Analytical Methods of Nonproliferation, was presented last fall at the Idaho National Engineering and Environmental Laboratory and will be taught this summer to between 20 and 40 students from across the nation by what Morse describes as a "dream team" of Livermore scientists.

"The course introduces graduate students to the key issues of nonproliferation issues and national policy," Morse explains. "I thought Livermore would be a good place to host the course," he says, adding that the course will serve as a way to attract talented graduate students to Livermore. Teaching will be coordinated by Simon Labov, director of the Laboratory's Radiation Detection Center.

Physics Professor Scott Davis works in atomic, molecular, and optical physics to develop new generations of sensors at NPS for the Department of Defense. Davis says, "A few years ago, Bill Kruer from Livermore worked for a couple of years at NPS and planted a seed in my brain about spending some time at Livermore." Davis was already familiar with the Laboratory—years ago, he had brought his graduate students to Livermore for a tour of the Nova laser.

After applying to the program, Davis was invited to Livermore to present a colloquium on ultraviolet (UV) imaging spectrometers developed at NPS. Davis arrived for a six-month stay in October 2004. He worked on two advanced remote-sensing techniques that are part of NAI's efforts to detect clandestine weapons of mass destruction.

The first research effort was a collaboration with chemist Nerine Cherepy to develop UV imaging and spectroscopy methods to detect radionuclides in the environment. This effort, funded by LDRD, takes advantage of the fact that alpha and beta particles cause UV fluorescence; that is, they glow in air. A UV imaging



Sabbatical scholar Edward Morse from the University of California at Berkeley (UCB) examines Livermore's Pelletron, a positron accelerator. Materials experiments will be performed on this accelerator by a UCB–Livermore team.

detection system could, for example, be used to assess and aid in the cleanup of an area contaminated by a "dirty bomb" or a radionuclide spill. Current experiments are being performed to evaluate airglow brightness for different response scenarios and to optimize detection efficiency.

A second effort Davis participated in investigated new types of infrared (IR) imaging spectrometers to identify chemical species at low concentrations in the atmosphere and quantify their concentrations based on their IR signatures. "IR signatures are generally specific to each type of molecule," says Davis. One aspect of the project explored new design options for a near-IR imaging spectrometer with higher resolving power than is available with current models. A second aspect investigated the potential application of new detector technologies to long-wavelength IR imaging spectroscopy, an area in which Livermore is an acknowledged leader. IR imaging spectrometers mounted on ships, airplanes, or unmanned airborne vehicles might, for example, remotely detect and measure effluents from facilities and provide insight into whether the facilities were involved in the manufacture of nuclear or chemical weapons.

Davis's host in NAI, Bill Conaway, notes that Livermore's long-standing relationship with NPS was strengthened last April when U.S. Navy Rear Admiral Patrick Dunne and Laboratory Director Michael Anastasio signed a Memorandum of Understanding establishing a framework for stronger collaboration in the area of national security. Conaway says a short-term benefit from Davis's stay was cross-fertilization among scientists, while a long-term benefit was building bridges between Livermore and the NPS. "Scott has excellent students as well as experience with sponsors different from ours," says Conaway. "We want to continue the momentum that he began."

New Emphasis

With the Sabbatical Scholars Program in its fifth year, the benefits continue to grow. There are an increasing number of opportunities to recruit scientific and engineering talent from the graduate students and postdoctoral researchers accompanying faculty. Many of these researchers stay in contact with their Livermore hosts, some return to the Laboratory as part of continuing collaborations, and two have become Livermore employees.

"The Sabbatical Scholars Program has been enormously successful," says Radousky. "The benefits keep coming."

—Arnie Heller

Key Words: Advanced Light Source (ALS), European Synchrotron Radiation Facility (ESRF), laser-heated diamond anvil cell (LHDAC), Naval Postgraduate School (NPS), Sabbatical Scholars Program, University Relations Program (URP).

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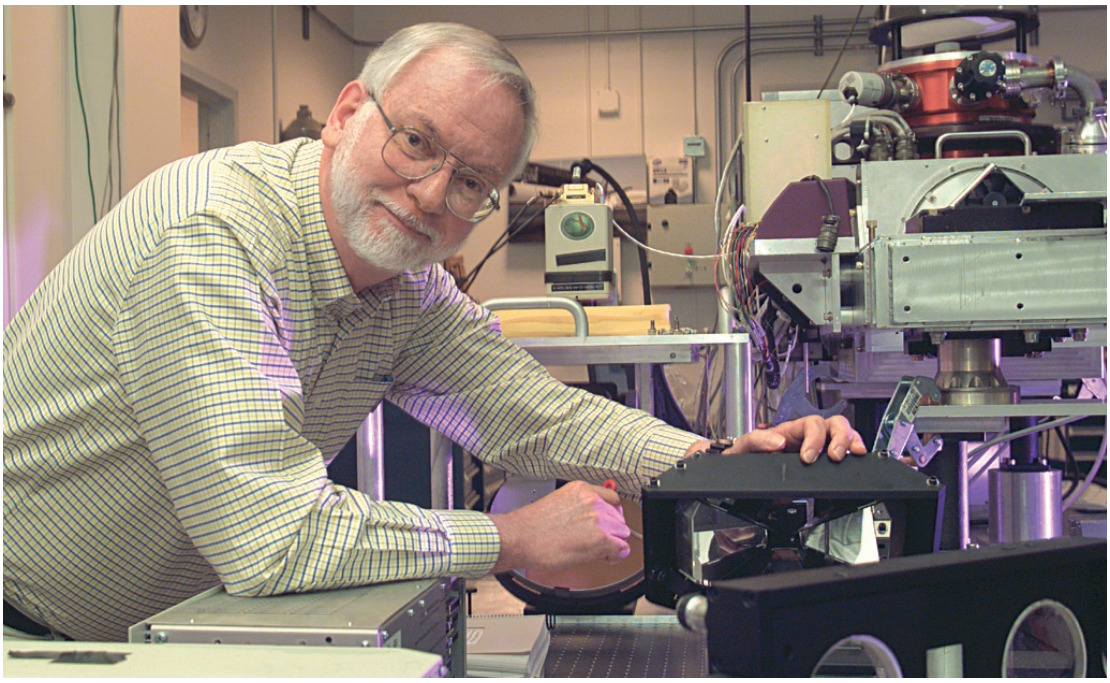

Sabbatical scholar Scott Davis from the Naval Postgraduate School works in Livermore's infrared imaging spectroscopy laboratory.